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## The Tools of Monitoring and Analyzing the Region Forest Sector Management Framework

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### **Abstract:**

*The paper highlights the issues of economic monitoring as an autonomous module of eco-economic forest sector management framework.*

*The research is aimed at development of research-backed tools of forest sector management framework's monitoring and analysis with a distinctive feature of a dedicated scale to evaluate the total economic effect of direct operation and harvesting, non-direct operation, ecological effect obtained through environmental, environment-forming, recreational functions of the forest, social effect, and real forest damage losses leading to normalizing the indicators with measurement rates.*

*Applying the suggested tools enables comparing and ranking the areas in the context of using the forest resources and managing the forest sector of the region.*

**Keywords:** monitoring, forest sector of the region, management, forest resources utilization, efficiency

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## 1. Introduction

In the modern context of globalization and increasing of anthropogenic load smart use of natural resources becomes possible only if the monitoring framework data is applied properly. Normally, the monitoring framework collects, organizes, and analyzes indicators of environmental condition and its state changes' factors, probability of the changes with environmental loads, and biosphere reserves (Zaretskaya, 2011; Albekov *et al.*, 2017; Ovchinnikov *et al.*, 2016). The monitoring is aimed at collecting, organizing, and analyzing the data on ecological background for managerial decisions' informational support purposes (Korchagin *et al.*, 2014). Therefore, the monitoring framework includes biosphere health as well as anthropogenic factors monitoring (Rodríguez *et al.*, 2016).

As analysis shows, current forest sector monitoring frameworks do not pay sufficient attention to the economic features of the environmental management. The monitoring has exceeded the frames of environmental management and touched upon the management and economic spheres. On the other hand, the economic evaluation of anthropogenic impact in Russia is still fragmentary due to lack of full-featured monitoring frameworks (Zinovyeva, 2014; Valma, 2014).

The existing term of eco-ecological monitoring considers the "management system" as an environment affected both by anthropogenic (lithosphere, atmosphere, hydrosphere) and economic factors (Naydenko *et al.*, 2003). The flipside is the authors' monitoring framework analysis highlights that economic component is minor and presented only at final stages like decision-making in managing the socioeconomic environment.

Myaskov and Biryulina (2010) noted that eco-economical monitoring should be aimed at comprehensive evaluation, analysis, decision-making and forecasting. Over the past decade, the problem of picking the set of appropriate monitoring tools becomes a milestone of actual systemic analysis and forest sector monitoring framework. Increasing number of researches conducted points out the scope and variety of objectives of eco-economical evaluation of areas (Bettinger *et al.*, 2017) as well as the fact that current subject matter includes lots of unsettled issues (Zinovyeva *et al.*, 2016).

## 2. Theoretical, Informational, Empirical, and Methodological Grounds of the Research

The key goal of forest sector monitoring and analysis framework is the determination of the forest resources' utilization efficiency (Boukherroub *et al.*, 2017). Therefore we suggest calculating the integrated forest resources efficiency application index for analysis purposes.

The first stage of calculating assumes determining  $Ee$ , the cumulative effect of

direct forest resources' utilization and harvesting as well as non-direct utilization (forest sector is divided into two unequal segments: forestry and forest management, and the scope of them depends on features of certain forest sector)

The value could be calculated as ratio between total VAT of lumber companies and total VAT of the region over a certain period. Depending on the corresponding range, the economic effect takes the value from 1 to 4, where 1 is to a slight effect, 2 is to a moderate effect, 3 is to a significant effect, and 4 is to a high effect (Table 1).

**Table 1.** Scale of evaluating the economic effect

Range	0-25%	26-50%	51-75%	More than 76%
<i>Ee</i>	1	2	3	4

The indicator noted above is measured in percentage to highlight the share of VAT of lumber companies in total VAT of the region and, as a result, to evaluate the significance of forest sector in a certain region. Research of IIED (International Institute for Environment and Development) shows that the contribution of forest sector to region's GDP is insignificant when not exceeding the 25%. When the forest sector's share is 26-60% then its contribution is significant. In the case when the share is 51-75% IIED considers the contribution to be of a high level. The forest sector exceeding the 76% share could be considered crucial in regional economy.

The second stage involves calculating the *Eec* (ecological effect from environmental-saving and environmental-saving functions) by means of ratio between air emissions capable to be refined by region's forest and total air emissions of the region. We defined the forest-refined emissions, according to Russian standards and regulations, at 5% of the total woodlands of the region. Depending on the certain range, the index is evaluated from 1 to 4, where 1 is to a slight effect, 2 is to a moderate effect, 3 is to a significant effect, and 4 is to a high effect (Table 2).

**Table 2.** Scale of ecological effect

Range	0-25%	26-50%	51-75%	More than 76%
<i>Eec</i>	1	2	3	4

The indicator noted above is measured in percentage due to the difference of ecological damage of the same emissions' volume but in various areas. Research of IIED (International Institute for Environment and Development) proved that excess of air pollutions over the pollutions refined by the forests of the certain area by less than 25% are considered minimal. Exceeding the 25% threshold indicates the significant damage to the environment. The damage evaluated at more than 50% level is considered of a high level. Index at more than 76% testifies critical damage.

The third stage involves calculating *Es* (social effect) as a ratio of forest area per resident. Depending on the certain range, the index is evaluated from 1 to 4, where 1

is to a slight effect, 2 is to a moderate effect, 3 is to a significant effect, and 4 is to a high effect (Table 3).

**Table 3.** *Scale of social effect*

Range	Less than 2,5 km	2,5-5 km	5-7,5 km	More than 7,5 km
<i>Es</i>	1	2	3	4

Ranges of the scale are based on the statistical research of IUCN (International Union for Conservation of Nature and Natural Resources). The fourth stage includes calculating *Er* (recreational forest function's effect) as a sum of revenues from recreational activity. Depending on the certain range, the index is evaluated from 1 to 4, where 1 is to a slight effect, 2 is to a moderate effect, 3 is to a significant effect, and 4 is to a high effect (Table 4).

**Table 4.** *Scale of recreational effect*

Range	Less than 2,5 mln.rub	2,5-5 mln.rub	5-7,5 mln.rub.	More than 7,5 mln.rub
<i>Er</i>	1	2	3	4

Ranges of the scale are based on the recreational activity revenues data of Federal State Statistics Service. The final stage is measuring the *D* index (actual damage caused by using of forests). The one could be calculated as a percentage of deforested area in the total amount of forests in the region. Measuring the value in hectare makes no sense since the same amounts of deforested areas cause different damage depending on the region. Depending on the certain range, the index is evaluated from 1 to 4, where 1 is to a slight effect, 2 is to a moderate effect, 3 is to a significant effect, and 4 is to a high effect (Table 5).

**Table 5.** *Scale of forest damage effect*

Range	0-25%	26-50%	51-75%	More than 76%
<i>D</i>	1	2	3	4

Ranges of the scale are based on the research of IUFRO (International Union of Forest Research Organizations) highlighting the forest damage thresholds adapted for regional measurements.

### 3. Results

After calculating the *Ee*, *Eec*, *Es*, *Er*, and *D* indicators we could measure the actual efficiency of utilizing the forest resources of the region:

$$Eef = \frac{Es + Eec + Es + Er}{16 \cdot D} * 100\%, \quad (1)$$

where *Eef* - efficiency of forest resources' utilization ratio.

Generally, the efficiency is measured in percentage. To explain the results, measured from 1 to 100%, we should refer to the UNDP (United Nations Development Programme) technique. Considering the complexity of the technique we note that it includes indicators with various measurement units. Authors developed special scales for unification reasons. The numerator is calculated depending on the certain scale of indicators. The denominator is additionally multiplied by 16 to achieve the target value in the range from 1 to 100%. Effective region's forest sector management considers providing high efficiency of the forest resources' utilization. Calculating the efficiency of forest resources' utilization allows comparing and ranking of most effective forest resources utilization and management areas.

A special scale is developed for regions' comparing reasons. Depending on a certain value of the indicator it could hit the corresponding range of the scale from 1 (less effective regions) to 4 (most effective regions) as in Table 6.

**Table 6.** Scale of efficiency of forest resources' utilization

Range	0-25%	26-50%	51-75%	More than 76%
<i>Eef</i>	1	2	3	4

As can be seen from the table 6, we highlight 4 ranges of *Eef* value. The ranges were developed by UNDP (United Nations Development Programme) which includes 189 countries, Russia among the number. Programme is executed for development aid to build sustainable economy and utilization of environmental resources. According to UNDP research, efficiency of less than 25% level is considered poor. This value indicates that forest resources are utilized unreasonably. Economic, ecological, social, and recreational effects are poor, but the forest resources damage is considered significant.

The efficiency below 50% is considered average. Current value indicates insufficiently reasonable utilization of resources, representing poor economic, ecological, social, and possibly recreational effect, but the damage turns to be of a high level. The efficiency in the range between 50% and 75% is considered as high, and the resources are utilized reasonably. Economic, ecological, social, and recreational effects are strong, and the forest resources damage is considered insignificant. We note that some values may vary. Efficiency at over 75% ratio is considered as extra high and indicates reasonable utilizing of forest resources as well as high level of economic, ecological, social, and recreational effect. The forest resources' damage is considered next to none. Current value is typical for developed countries with a forest-protection agenda.

We suggest using an additional tool for monitoring and analysis purposes. The tool is forest resource reserves' ratio (*Eres*) and could be calculated as follows:

$$E_{res} = \frac{E_s + \Delta z + \Delta v + E_{ec} + E_s + E_r}{D_{min}}, \quad (2)$$

Where  $\Delta z$  is to change in reserves not utilized in harvesting process, ha;

$\Delta v$  is to change in unused recoveries, ha;

$D_{min}$  is to the minimal environmental damage potential in forest resources utilization.

The value of  $D_{min}$  could be calculated as follows:

$$D_{min} = \sum_{i=1}^k F_{ent}, \quad (3)$$

Where  $F_{ent}$  is to the amount of forest resources required for  $i$  entity, ha;

$k$  is to total amount of the entities in the region.

#### 4. Conclusions and recommendations

The suggested framework of measuring the possible and actual forest resources utilization efficiency is used as a basis of planning in forest management and evaluating the region forest management framework's evaluation in efficiency rates for the sustainable development purposes. In terms of environmental protection, the probability providing manageable region's production intensification including meeting the requirements and resources utilization at full extent comes to life.

Applying the current set of tools along with considering the forest resources efficiency increases the local authorities' amenability for reasonable forest resources utilization. Considering data on performance and production level, obtained through analysis process, local authorities are allowed to give conclusions on projects of locating the harvesting facilities on areas within their jurisdiction. In case of highlighting the poor efficiency of management, restrictions boosting the efficiency level could be imposed on the region.

Calculating the actual efficiency of region forest resources' utilization is suggested to be a basic tool for solving local issues of strategic planning and sustainable forest management. Evaluating the forests' resource and ecological potential, supporting forests' balanced utilization modes as well as evaluating and forecasting are the most important objectives of forest planning and sustainable management.

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